Summary of Meeting #5, of RTCA SC-186, Working Group 5
For the Development of a MOPS for UAT

The meeting was held on 19 – 22 June 2001, at the facilities of MIT Lincoln Laboratory at Hanscom AFB in Lexington MA, hosted by Val Heinz. The meeting was called to order at 9 a.m. on June 19, 2001 by Co-Chairman George Ligler. George provided introductory remarks, welcomed all attendees and asked that each one introduce themselves and their organization. The attendees included:

Larry Bachman – JHU – APL	Val Heinz – MIT Lincoln Laboratory	Al Muaddi – JHU – APL
Mike Biggs – FAA (ASR-200)	Richard Jennings FAA (AIR-130)	Vincent Nguyen – FAA SafeFlight 21
George Cooley – UPS Aviation Technologies	Stan Jones – Mitre CAASD	Tom Pagano – FAA TC – ACT-350
Nikolaos Fistas – Eurocontrol	Todd Kilbourne – Trios Associates	Ed Valovage – Sensis Corp.
Gary Furr – Titan Corp - FAATC – ACT-350	Ian Levitt – Titan Corp - FAATC–ACT-350	Rich Weathers – JCS J6T - Pentagon
Carl Gleason – Advanica FAA/NISC	George Ligler – PMEI	Warren Wilson – Mitre Corp.
Tom Goblick – MIT Lincoln Laboratory	James Maynard UPS Aviation Technologies	Gene Wong – FAA – AND-530
William Harman – MIT Lincoln Laboratory	Chris Moody – Mitre CAASD	

1. Following introductions, known regrets were announced as follows:
   - Terry Stubblefield as been assigned to another project and will be leaving WG-5
   - Greg Kuehl
   - Tom Teetor
   - Jerry Anderson

2. The Working Group was asked to review and approve the Minutes to Meeting #4. There were no comments and hearing none, the Minutes of Meeting #4 were approved.

3. The Working Group then reviewed the schedule of future meetings. Gary Furr presented several slides with maps of the FAA Technical Center, and discussed the requirement for registering member attendance prior to arrival at the Tech Center because of security requirements. It was agreed by the Working Group that all attendees to Meeting #5 would automatically be registered for attendance at Meeting #6 at the FAA Technical Center. **Only those WG-5 Members not attending Meeting #5 would need to inform Gary Furr via phone or email of their intention to attend Meeting #6 not later than COB 20 July 2001.** The following table indicates the currently agreed upon meeting dates and places for meetings of RTCA SC-186 Working Group #5.

Proposed dates and places for future meetings of the UAT MOPS Working Group 5:

Dates/Time	**Meeting Place**
July 31, 9:00 through noon August 3	FAA WJH Technical Center, Atlantic City Airport, NJ Travel info and lodging details are available on the ADS-B/UAT web site
9am Tuesday, 25 Sept to 4pm Friday, 28 Sept.	Brussels – Eurocontrol Headquarters, hosted by Nikos Fistas Travel info and lodging details are available on the ADS-B/UAT web site
9am Tuesday, 6 Nov to noon Friday, 9 Nov	Location TBD – either FAA-TC, Atlanta, Norfolk Action Rich Jennings to speak to Delta, Rich Weathers to investigate Norfolk opportunities

Regarding future meetings, the Working Group discussed concerns over the continued scheduling of one day SC-186 Plenary Meetings in conjunction with co-located meetings of WG-1 and WG-4. WG-5 inquired of RTCA Management as to the future schedule for the next SC-186 Plenary and was informed that it will be held in Brussels Belgium in conjunction with WG-1 and WG-4 meetings between October 1 and 4, with the one day Plenary scheduled for 3 October 2001. WG-5 had previously scheduled a meeting at Eurocontrol Headquarters for 25 September through 28 September. It was agreed that one of more WG-5 members would remain in Brussels and attend the one day

Plenary on 3 October 2001. Possible representatives included Stan Jones, Rich Jennings and George Cooley.

4. Moving to Agenda Item 4a, the Working Group began a review of all Open Action Items with the review of Working Paper WP-5-09 as presented by Ian Levitt. Ian indicated that testing at the FAA Technical Center had been completed on three DME interrogators, the (1) Bendix King, KD-7000, the (2) Narco DME-900 and the (3) Honeywell KDM-706A. The Honeywell unit is one of the two DME units specified as requiring testing from units used primarily in Europe. Ian described the test set-up and presented a set of graphs of the results for each unit. He concluded that measurements of the three DMEs appear consistent with each other and that there were no surprises in the data collected. He further concluded that DME operation does not appear to be overly sensitive to constant phase interference. He does not expect there to be much of a problem caused by near- or co-channel UAT operations. Discussion by the Working Group agreed that it would be difficult to model DMEs at the pulse-to-pulse level. Representatives from Johns Hopkins Applied Physics Lab agreed that they would have difficulty using the actual data gathered in these tests by the FAA Tech Center to generate a simulation.

5. Continuing with Agenda Item 4a, Al Muaddi of JHU-APL presented Working Paper WP-5-16 detailing his observations of the Impact of UAT on DME. Al outlined his approach for the simulation and detailed the use of data forwarded to JHU-APL by the FAA Technical Center, as per Action Item 3-2. Al concluded that for the particular scenario modeled, the DME interrogator remains in the TRACK state for more that 98% of the time. Whenever it does revert to SEARCH mode, it remains in that mode for typically less than a few hundred milliseconds before acquiring a track and re-entering the TRACK state. Working Group discussion following Al's presentation agreed that Link-16 scenarios will be added to the simulation. Al will revised the simulations and report at Meeting #6.

   Further Working Group discussion concerning the UAT frequency and DME operation led the Working Group to agree that we will adopt the frequency 978 MHz as a working assumption going forward. This frequency will be bracketed when referenced in documentation and it will be noted that the frequency of 978 MHz is To Be Confirmed (TBC). Adopting this frequency will not require any change to DMEs in the United States and will cause the least amount of impact in Europe.

6. Also, as a part of Agenda Item 4a, Tom Pagano presented Working Paper WP-5-10 regarding UAT Co-site Interference Testing at the FAA Technical Center. Originally, there was a TLAT question as to interference effects of on-board transmitters on a UAT receiver – for modeling purposes. Because of high power transmissions of on-board transponders, 1090 MHz ATCRBS and Mode-S replies were deemed potential interferers. The FAA Technical Center established a bench configuration to measure UAT receiver performance with ATCRBS overlaps since there are the predominant transmissions. Tom reports that the units tested included (1) Bendix King KT-76C, (2) NARCO AT-150, and (3) Honeywell XS-950 Data Link. Tom offered a series of plots showing measurements with UAT at 966 MHz and at 981 MHz. Tom concluded that the data collected on the 981 MHz tests performed on the Capstone units indicates similar results to testing performed on the 966 MHz units. There was no significant immunity difference and the Co-site impact of 1090 MHz ATCRBS and Mode-S was more evident with the 981 MHz units since the frequency gap is less. Chris Moody and Stan Jones questioned using the long UAT Message instead of the longer uplink message. Tom agreed to accept **Action Item 5-5** and to re-run the Co-site tests using the longer uplink messages.

7. Again as part of Agenda Item 4a, Mike Biggs presented Working Paper WP-5-13 regarding the Assigning of DME Channel 17X. Mike notes that "in the ICAO DME channel plan, there is a footnote stating that '… DME operating channel 17X may be assigned for emergency use.' The purpose of the Working Paper was to provide guidance as to the intent of that footnote." Because of this note, 17X is not used in the United States for operational DME's. Instead, it (together with 18X) is reserved for DME Ramp testers. This condition has driven 17X – or 978 MHz – to be the leading candidate

frequency for the operational UAT system. Mike reports that the review of 978 MHz use in Europe however, led to the discovery that it is being utilized to a limited extent there. As a result Mike tried to determine clarification of the term "emergency use" in conjunction with those uses of the 978 MHz frequencies. Mike reported that there was no straightforward answer. Nikos Fistas agreed that there are six DMEs in Europe operating at 978 MHz, and he agreed to check to see if he can determine the reasons for "emergency use."

8. As part of Agenda Item 4a, Mike Biggs presented Working Paper WP-5-14, which discusses questions raised at the April UAT meeting regarding requirements on spurious emissions for UAT. Mike reports in WP-5-14 a review of available materials, and proposed limits for inclusion in the UAT MOPS. After discussion, Working Group 5 agreed with Mike's recommendations and instructed writers of UAT MOPS requirements to incorporate the appropriate language into Section 2.2.

9. The Working Group started Wednesday Morning with Agenda Item #6 and Nikolaos Fistas presented Working Paper WP-5-19 as a summary of discussions in the recent AMCP WG-C meeting related to the possibility of starting SARPS for UAT. Nikos reports that WG-C agreed that it should conduct a comparative analysis in order to establish whether the need for UAT SARPS could be justified on the basis of any additional benefits that the UAT would be able to deliver over and above the existing ADS-B candidate links already included in Annex 10 (SSR Mode-S extended squitter and VDL Mode 4), conditional on the resolution of any associated substantive issues. The meeting also agreed that in addition to considering additional benefits that could derive from the UAT, all substantive issues with the UAT that would be identified during the course of the comparative analysis and which might prevent the development of SARPS, such as availability of spectrum, should be investigated and resolved. With regard to the final outcome of the comparative analysis, the WG-C Secretary informed WG-C that, should the comparative analysis support the need for UAT SARPs, a recommendation to develop SARPs should be produced by WG-C and conveyed to AMCP. Should AMCP support the recommendation from WG-C, the Secretary would then undertake to submit the recommendation to the Air Navigation Commission and request that the work program of the panel be amended accordingly.

10. Returning to Agenda Item 4a, Nikolaos Fistas presented Working Paper WP-5-15, which summarized the current and planned usage of the 978 and 979 MHz DME frequencies in Europe. The two frequencies correspond to the frequencies used for the replies of the DME ground equipment to aircraft interrogations in the channels 17X and 18X. A review of the usage of 978 MHz shows 1 DME, 4 TACAN and 1 VOR/DME. WP-5-15 further investigated the reallocation of assignments in channel 17X. The investigation of the assignments in 978 MHz showed that for the assignments in the non-core European area, it is possible to find a number of alternative frequency assignments. However, in the core European area, the options for reallocation are limited and may require frequency changes for multiple navigation ground stations.

11. Warren Wilson presented Working Paper WP-5-07, which addressed the issue of the difference in UAT ground uplink performance in the presence of JTIDS/MIDS interference depending on whether or not the uplink time slots are permuted. The conclusion of Warren's presentation was that the results of his work indicate that UAT time slot permutation will be necessary if JTIDS/MIDS transmitters are permitted to operate in *any* of the scenarios described in UAT-WP-4-04. This conclusion assumes that the uplink range requirement is approximately 100 NM and that JTIDS/MIDS is allowed to hop on frequencies at and/or close to the UAT operational frequency. If either of these conditions changes, the conclusion might also change.

    Warren noted that the time-slot permutation algorithm need not be very complex. Simply incrementing all slot assignments by one each second would suffice. The main complication in the permutation operation would be in coordinating the ground transmitters so that they not only recognize one-second boundaries, but also have absolute time information. **Action Item 5-8** was accepted by George Cooley to take a look at the design implications of permutation and report at Meeting #6. Subject to George's confirmation, the Working Group agreed to use permutation.

12. Warren Wilson then presented Working Paper WP-5-08, which provided analysis of the sensitivity measurements previously reported in UAT-WP-4-13. Warren's work additionally provided an analysis of some new measurements on co-channel performance. Warren's focus in WP-5-08 was to determine the performance difference between two proposal IF Receiver filter bandwidths. His conclusion was that the difference appears to be slight in the case of sensitivity measurements. That is because the decrease in signal-to-noise performance is compensated by a corresponding decrease in the effective noise level. This phenomenon does not persist in the co-channel interference case, where there appears to be about a 4 dB performance penalty associated with using the narrower filter. Thus, the choice of filter is not obvious. It depends on the relative importance of minimizing the effects of self-interference *versus* the effects of interference from DME ground transmitters on neighboring channels. (The difference in performance in JTIDS/MIDS scenarios may be minimal: Warren Wilson agreed to validate this by accepting **Action Item 5-10**) If the operating frequency of UAT is put at 978 MHz, then there may actually be no such interference within the United States. Thus, the question may be reduced to interference scenarios involving DME transmitters situated outside the United States (e.g., Europe).

13. Following Agenda Item 4c, Larry Bachman presented WP-5-18, which primarily dealt with UAT Sensitivity. Flowing through the presentation, the Working Group discussed the currently proposed Power Levels of equipment classes. As currently proposed, A0/A1 is 5 to 12.5 watts, A2 is 12.5 to 31 watts and A3 is 100 to 250 watts. The conclusion of the Working Group was to hold the A3 power at the current level and investigate how much we may need to increase the A0/A1 power levels. George Cooley accepted **Action Item 5-9** to take a look at the differences in cost as power levels increase or decrease on A0, A1, A2 and A3 equipage classes. The Working group continued to discuss the possibilities of further simulations to be run by JHU-APL and Larry agreed to run all measures of performance as presented in WP-5-18. Larry agreed that the scenarios will be re-run with the 1.2MHz filter first. If the performance is acceptable, then the 0.8MHz filter case will not be run.

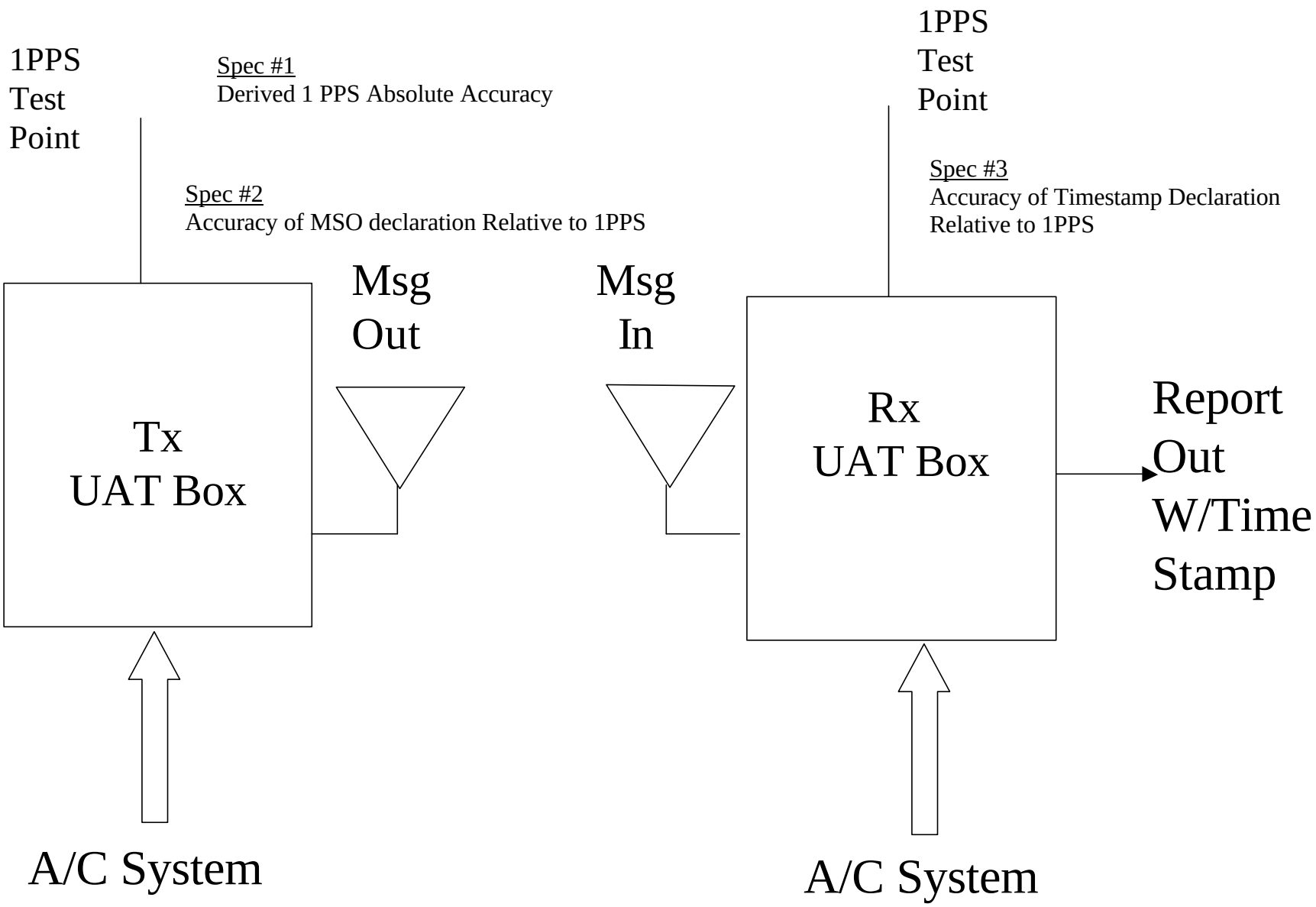
14. The Working Group agreed to use the following Reed Solomon codes in the UAT MOPS; (30,18) for the short message; (48,34) for the long message; and (92, 72) for the uplink message.

15. The Working Group turned discussion toward Agenda Item 5a and in a discussion of the UAT Spectral Mask, which is referenced in Section 2.2.2.5 of the Draft Proposed UAT MOPS presented in WP-5-01 by Chris Moody. George Cooley accepted **Action Item 5-11** to make a comparison of the Spectral mask when transmitted through different filters. George Cooley also accepted **Action Item 5-12** as an effort to re-measure the transmit spectrum to +/-5 MHz, and also give the occupied bandwidth.

16. Starting Thursday Morning in a pre-meeting session, an interested subgroup on equipmemt testing met to determine how to modify some of the existing Capstone UAT boxes by making any changes necessary to comply with what we currently know about UAT MOPS requirements. The SafeFlight 21 Office will consider funding some of the modifications to existing UAT Capstone boxes for the purpose of running these MOPS Tests. A decision was made by the Testing Subgroup to use 981 as the frequency and to make other known changes to the boxes for the MOPS testing. The lead decision making tool will be the analysis by Larry Bachman running performance curves with the two different filters (800KHz and 1.2MHz). It was agreed that Larry would send his analysis to Gary Furr and Gary will send it back out to the WG-5 distribution list. There will be a teleconference set up a few days after the distribution of the analysis to discuss the results. George Cooley will also send his report to Gary Furr for distribution. A decision on the Spectral Mask, the output power and the Filters will need to be made at the July Meeting at the FAA Technical Center.

    During renewed and further discussions related to the power levels discussed in Larry Bachman's Working Paper WP-5-18, the Working Group agreed that we may need to decouple the A0 and A1 power levels. The Working Group further agreed that the power level of the A3 equipment would be set at 100 to 250 watts.

Figure 1


1PPS
Test
Point
Spec #1
Derived 1 PPS Absolute Accuracy
Spec #2
Accuracy of MSO declaration Relative to 1PPS
Msg
Out
Tx
UAT Box
A/C System
Msg
In
1PPS
Test
Point
Spec #3
Accuracy of Timestamp Declaration
Relative to 1PPS
Rx
UAT Box
Report
Out
W/Time
Stamp
A/C System

17. As part of Agenda Item 4g, Warren Wilson presented his Working Paper WP-5-11A, which was in response to Action Item 4-2. In WP-5-11A, Warren provided some additional information regarding synchronization procedures for UAT (beyond what was discussed in UAT-WP-4-12). Following the presentation of WP-5-11A, the Working Group agreed to combine the work in WP-5-11A with Warren's previous work to create Appendix H entitled "Synchronization Processing Information."

18. For Agenda Item 4h, and in response to Action Item 3-22, Stan Jones presented Working Paper WP-5-12, dealing with the Latency in ADS-B. Following the presentation of Stan's paper, there was considerable discussion by the Working Group on latency and delays in the system. Reporting on email from Garmin, Chris Moody pointed out that there is a possible GPS error of 2.7 microseconds using –700ns to +2,000ms. Additionally, Section 2.2.5.3.2 of the draft UAT MOPS states that there is an additional possible delay based on the MSO of +/- 320ns. One of the questions that we have to answer is "what will be needed to specify anti-spoofing measures required in the equipment?" Chris Moody drew Figure 1 on the board and the Working Group discussed the three specifications in relation to requirements for Section 2.2. Chris agreed to draft strawman requirements in this area, based on the Working Group discussion, for the July Meeting at the FAA Technical Center.

    It was additionally felt that we would specify a requirement in Section 3 (perhaps the requirement shown in Figure 1 as Chris's #1, if the GPS is integral to the UAT box) for installed equipment. The Working Group also agrees that we may need to specify requirements for extrapolation in the transmitter based on requirements in the ADS-B MASPS at Section 3.3.3.2.

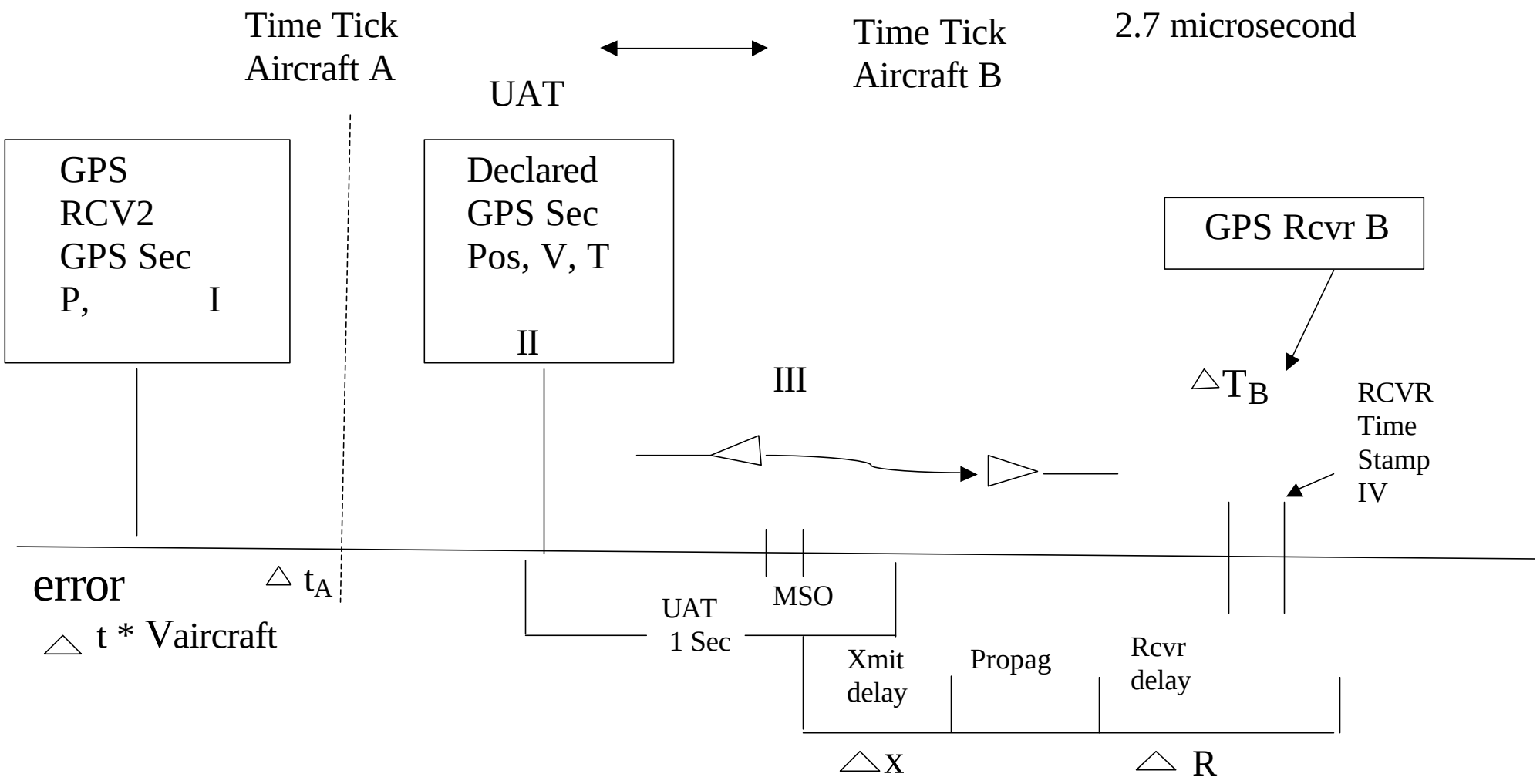
19. Carl Gleason presented Working Paper WP-5-17 as part of Agenda Item 4f, relaying some of the experiences of the Capstone Project and lessons learned.

20. Starting on Friday morning in a pre-meeting discussion, most of the Testing Subgroup discussed the initial draft of the "UAT Interference Measurement Test Plan," which was put together by Tom Pagano as a preliminary means of establishing testing criteria for testing the modified UAT Capstone boxes for UAT MOPS testing. The Testing Subgroup agreed that we need to specify a test environment to come out of these preliminary tests to designate an environment for manufacturers such that they do not have to purchase all DME's and/or JTIDS simulators in order to run test procedures that will be identified in the MOPS to be certified. Warren Wilson and Chris Moody pointed out that the JTIDS lab at Mitre Bedford will be moving during the time frame when the Working Group will need to do testing. Rich Weathers indicated that it is possible to do testing at the Joint Spectrum Center (JSC) in Annapolis MD.

    Mike Biggs drew Figure 2 on the board in an attempt to understand the latency discussed during the presentation of WP-5-12, and the discussion of Thursday afternoon.

21. Following this initial discussion on UAT MOPS testing, as a part of Agenda Item, Chris Moody presented his Working Paper WP-5-02, which outlined a concept for the use of a temporarily assigned address for ADS-B. As proposed in the Working Paper, the use of such an address could be either to provide total anonymity, or anonymity to all but Air Traffic Control (ATC). What followed was a healthy debate on the use of anonymous addresses in general. It was pointed out that European users are against any form of anonymous addressing, and Carl Gleason spoke on behalf of ATC and indicated that they disagree with the section of the ADS-B MASPS (Section 2.1.2.1), which allows provisions for setting an anonymous address. Carl indicated that he will complete a request to WG-6 for a change in Revision A of the MASPS in Section 2.1.2.1, indicating at any user that requests services from ATC must have a defined address. Chris Moody agreed to take the input of the discussion from WP-5-02 and incorporate it into requirements in the next revision to Section 2.2.

Figure 2


Time Tick
Aircraft A
UAT
Time Tick
Aircraft B
2.7 microsecond
GPS
RCV2
GPS Sec
P, I
Declared
GPS Sec
Pos, V, T
II
GPS Rcvr B
III
△T_B
RCVR
Time
Stamp
IV
error
△ t * Vaircraft
△ t_A
UAT
1 Sec
MSO
Xmit
delay
Propag
Rcvr
delay
△X
△ R

22. In the few minutes prior to noon, Friday 22 June, it was agreed that Gary Furr would present Working Paper WP-5-03, which summarized the email debate on the length of the field for the Call Sign. The ADS-B MASPS in Section 2.1.2.1.1 calls for the Flight ID/Call Sign of up to 7 characters in length. But, in Section 3.4.4, Table 3-6, the definition for the Mode Status Report calls for "up to 8 alpha-numeric characters." The conclusion of WP-5-03 was to suggest that the number in Section 3.4.4, Table 3-6 be changed to a minimum requirement of "7" characters. During a brief discussion on the topic, Jim Maynard informed the Working Group that this topic was discussed the previous week at the AEEC Meeting in Atlanta and that they had agreed to suggest to WG-6 that the MASPS Section 2.1.2.1.1 be changed to a minimum of "8" characters. WG-5 agreed that this position should be taken forward to the next meeting of WG-6 for Revision A of the ADS-B MASPS.

23. Prior to adjourning the Meeting, the Working Group reviewed Open Action Items, the Orphaned Issues List, and the Agenda for Working Papers, which were not presented at this meeting because of lack of time. WP-5-01 was not reviewed in detail and will be superseded by Draft #4 of Section 2.2 to be presented by Chris Moody at the next meeting. WP-5-04 was withdrawn from presentation because of basic flaw in the assumption wherein Ian Levitt used the range –700 to +2000 microseconds instead of the specified range of –700 to +2000 nanoseconds as specified by Garmin at the April UAT Meeting in Salem Oregon. WP-3-09 was not reviewed and will be held over to Meeting #6. WP-5-06 submitted by Warren Wilson on the UAT Ground Uplink Message Format, will be reviewed by Warren and Chris Moody for inclusion into the next draft of Section 2.2. And, finally, WP-5-05, which is a draft of Section 4, submitted by Greg Kuehl, will be placed on the Agenda of Meeting #6 for review.

24. During the 1st meeting of WG-5, December 18, 2000, the Working Group reviewed the sections of the proposed UAT MOPS and worked through the identification of individuals and organizations that would be responsible for writing drafts of those sections. The following table is the result of the assignments of those writing actions. The asterisk (*) beside a name indicates the lead person or organization.

UAT MOPS Writing Assignments

Section	Version / Filename	Date / Due	Primary Author(s)	Status/Comments
1.0 Introduction	Sec_1a.pdf	3/27/01	Bill Flathers * Jerry Anderson	
2.1 General Requirements	Sec_2-1b.pdf	3/27/01	Tom Mosher	
2.2 Equipment Performance Requirements	Sec_2-2b.pdf	04/27/01	Chris Moody * Bob Saffell Rich Weathers Jim Maynard JHU-APL (?)	
2.3 Environmental		Due after 2.4	Small 2.4 group	
2.4 Equipment Test Procedures			Tom Pagano * Bob Saffell UPS-AT Chuck LaBerge JHU-APL (?)	
3.0 Installed Equipment Performance				
4.0 Equipment Performance Characteristics	Sec_4c.pdf	06/07/01	Greg Kuehl	

Section	Version / Filename	Date / Due	Primary Author(s)	Status/Comments
A. Glossary & Acronyms	App_A3.pdf	06/05/01	Rich Jennings	
B. MASPS Cross Reference Matrix	App_B1.pdf	01/03/01	Greg Kuehl Jim Maynard Nikos Fistas JHU-APL (?)	
C. Example ADS-B Message Encoding			Chris Moody + 2.2 writers	
D. UAT Ground Infrastructure	App_D1.pdf	02/14/01	Ed Valovage * Paul Gross	
E. Aircraft Antenna Characteristics				
F. Link Budgets & Scenario Dependent Ranges			Larry Bachman	
G. Standard Interference Environments			Mike Biggs	
H. Synchronization Processing Information			Warren Wilson	

25. The following table indicates the currently agreed upon meeting dates and places for meetings of RTCA SC-186 Working Group #5.

Proposed dates and places for future meetings of the UAT MOPS Working Group 5:

Dates/Time	Meeting Place
9am Tuesday, 31 July to noon Friday, 3 August	FAA WJH Technical Center, Atlantic City Airport, NJ Travel info and lodging details are available on the ADS-B/UAT web site
9am Tuesday, 25 Sept to 4pm Friday, 28 Sept.	Brussels – Eurocontrol Headquarters, hosted by Nikos Fistas Travel info and lodging details are available on the ADS-B/UAT web site
9am Tuesday, 6 Nov to noon Friday, 9 Nov	Location ***TBD*** – either FAA-TC, Atlanta (Delta Airlines), or Norfolk **Actions:** Rich Jennings to speak to Delta, Rich Weathers to investigate Norfolk opportunities, Report at Meeting #6 at FAA-TC

26. The following **Action Items** were identified during the course of this and previous meetings. The asterisk (*) beside a name or organization indicates that they are the lead for the resolution of that Action Item. Actions shown here are those Action Items that remain OPEN.

Action Number	Action Description	Assigned to	Status
2-15	Derive to the degree possible, performance requirements for UAT delivery of FIS-B products, from the FIS-B MASPS.	George Ligler Bill Flathers Stan Jones	Provide at Mtg #6

Action Number	Action Description	Assigned to	Status
3-2	Interchange of FAATC work product into APL simulations. Addition of ground uplinks into APL full-scale simulation. **Preliminary data on the first DME by Mtg. #4. Larry with a status report at same meeting. The FAATC submitted data to APL prior to June 1st. FAATC will provide data on further DMEs.**	Larry Bachman Tom Pagano	APL to run simulations for presenting at Mtg 6
3-3	Additional data collection on DME equipment: Honeywell, General aviation unit, and additional equipment as has been specified by Eurocontrol. Presentation on data from FAATC from original Bendix and Narco units at Meeting #5.	Tom Pagano Ian Levitt	Partially Addressed by **WP-5-09** **Further info Mtg 6**
3-6	Mike and Gondo to determine criteria for acceptable DME performance in the presence of UAT interference	Mike Biggs Gondo Gulean	Report for Mtg. #6
3-10	Bob to focus on necessity of database, frequency selection to avoid DMEs, and cost feasibility (using single channel implementation as baseline cost) of BAE proposal.	Bob Prill	George Ligler will contact Bob. See Action 5-15
3-13	Warren and Larry will provide preliminary simulation results of the following scenarios: -Baseline JTIDS and each UAT self-interference scenario (LA 2020 and low-density) (Mtg #4) -High density JTIDS and low-density UAT self-interference (Mtg #5) -Low density JTIDS and LA 2020 (Mtg #5)	Warren Wilson Larry Bachman	Partially addressed by **WP-4-05** **WP-4-14** **WP-4-16** **WP-4-17** Additional Scenarios at Mtg 6
3-19	Al will run the scenarios provided from Action 3-18 (if available), and from LA Basin, and do additional analysis on UAT performance in the presence of DME adjacent channel interference only.	Al Muaddi	"Guaranteed" for Meeting #6
3-25	Perform an initial investigation to define and develop an RF UAT message generator to simulate high-density scenarios. Determine the schedule and resource requirements to complete.	Ian Levitt Tom Pagano (*)	Status report at Mtg #6
4-3	Run his models on all JTIDS scenarios (9), two 1 MHz offset DME scenarios, and self interference, as appropriate to the JTIDS scenarios, with power levels agreed to at Meeting #3 -- with labeled axes (and no yellow lines) -- for Meeting 7	Stan Jones	
4-9	Provide a spectral mask for section 2.2.2.5 for Mtg #6	Warren Wilson Chris Moody George Cooley	See Actions 5-11 & 5-12
4-14	Establish subparagraphs to section 2.2.5.2.2, and/or notes to the table in section 2.2.5.2.2	Stan Jones Chris Moody (*) Larry Bachman	
5-1	Continue testing DME units and report at Meeting #6	Ian Levitt	
5-2	To facilitate getting Theory of Operation Manuals on DMEs to JHU-APL	Rich Jennings	Done **CLOSED**
5-3	Information on JTIDS/DME Interference to JHU-APL	Warren Wilson	
5-4	Update simulations with JTIDS and DME theory information and report at Meeting #6	Al Muaddi	
5-5	Rerun Co-site Interference tests using longer uplink messages for Meeting #6	Tom Pagano	

Action Number	Action Description	Assigned to	Status
5-6	Put old coding into the simulation and run to see if the result is similar to the curves that were presented in the Co-site testing presented by Tom Pagano	Al Muaddi	
5-7	Simulate UAT/JTIDS Ground environment	Warren Wilson	Addressed by **WP-6-03**
5-8	Take a look at the design implications of permutation	George Cooley	
5-9	Take a look at differences in cost as power levels increase or decrease on A0, A1, A2 & A3 equipage classes	George Cooley	
5-10	Validate Link 16 scenario on both filters	Warren Wilson	Addressed by **WP-6-02**
5-11	Comparison of Spectral Mask when transmitted through different filters	George Cooley	
5-12	Re-measure the transmit spectrum to +/-5 MHz, and also give the occupied bandwidth	George Cooley	
5-13	Look at A0/A1 air-ground performance in dense terminal areas	Larry Bachman	
5-14	Walk up the power for A0/A1 to get margin and SV performance, and, to run an aircraft at 18,000 feet, and then one at 40,000 feet	Larry Bachman	
5-15	Get with Bob Prill about Action Item 3-10	George Ligler	
5-16	Accuracy of the time synch availability on various aircraft. What part of the 2.7 microsec is static versus variable?	Chris Moody Stan Jones George Ligler	

27. The **Working Papers** shown in the following table are specifically for the Meeting being reported in these Meeting Minutes. Working Papers for all WG-5 Meetings, as well as the Meeting Agendas, Meeting Minutes, Meeting Schedules and files leading to the production of a UAT MOPS are posted on the ADS-B UAT web site at: http://adsb.tc.faa.gov

SC-186 Working Group 5 – MOPS for UAT – Working Papers

Working Paper	Size	Description	Introduced At:
UAT-WP-5-01	63KB	The 3rd Draft of Section 2.2 with additional text added to describe some of the ADS-B Message Payloads in more detail, presented by Chris Moody	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-02	26KB	This paper outlines a concept for use of a temporarily assigned address for ADS-B, presented by Chris Moody in response to Action Item 4-5	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-03	21KB	Review of the Issue of Flight ID brought up by Ron Jones and summarized by Gary Furr	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-04	16KB	UTC Time Mark Stability and Other Range Validation Specification Issues, presented by Ian Levitt in response to Action Items 3-21 and 4-13	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-05	28KB	The 3rd Draft of Section 4 of the UAT MOPS with added text in blue font, presented for review by Greg Kuehl	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-06	18KB	Proposed UAT Ground Uplink Message Format, presented by Warren Wilson in response to Action Item 4-11	Meeting 5, 06/19/01 MIT-LL, Hanscom

Working Paper	Size	Description	Introduced At:
UAT-WP-5-07	26KB	The Effect of Time Slot Permutation on UAT Ground Uplink Message Performance in the Presence of JTIDS/MIDS Interference, presented by Warren Wilson in response to Action Item 4-12	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-08	41KB	Updated UAT Performance Model and Co-channel Interference Results, presented by Warren Wilson and Tom Mosher	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-09A	167KB	Measurements of UAT Interference effects on DME Interrogators, presented by Ian Levitt and David Thomas in response to Action Items 3-1 and 3-3	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-10	43KB	UAT Co-site Interference Testing, presented by Tom Pagano in response to Action Item 3-20	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-11A	47KB	More UAT Synchronization Issues, presented by Warren Wilson in response to Action Item 4-2	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-12	20KB	ADS-B compensated and uncompensated latencies, presented by Stan Jones in response to Action Item 3-22	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-13	9KB	Assigning DME Channel 17X, presented by Mike Biggs in response to Action Item 3-7	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-14	9KB	Spurious Emission Limits, presented by Mike Biggs in response to Action Item 4-10	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-15	139KB	Results on the utilization of the frequencies 978 and 979 MHz in Europe, presented by Nikos Fistas in response to Action Item 3-9	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-16	434KB	The Impact of UAT on DME, presented by Al Muaddi in response to Action Item 3-19	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-17	672KB	Some Operational Experience from Capstone "Radar-Like Services," presented by Carl Gleason in response to Action Item 4-6	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-18	2,245KB	UAT Sensitivity, presented by Larry Bachman in response to Action Item 4-4	Meeting 5, 06/19/01 MIT-LL, Hanscom
UAT-WP-5-19	30KB	Discussions in AMCP Working Group C meeting concerning starting SARPS for UAT, presented by Nikos Fistas	Meeting 5, 06/19/01 MIT-LL, Hanscom

28. As part of an on-going effort to retain knowledge of items that might otherwise be forgotten, we have created and maintain the following table of "Un-Resolved" or "Orphaned" Issues. This list is reviewed during each meeting and is updated as needed.

Un-resolved Issues or Questions not tracked specifically by Action Items

Issue #	Issue/Question Description	Raised by	Date Raised	Status
1	What is the best approach to determining the length of the ADS-B message for proper R/S decoding? If a separate 8 bit length ID field is used outside the R/S block – as is the current Capstone approach – could a half rate code supporting 4 information bits be supported to identify payload type? If the length ID is only 2-state, could it be shortened from 8 bits?	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-4-15** **CLOSED**
2	What is the best combination of CRC and FEC for meeting integrity requirements most efficiently	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-4-15** **CLOSED**

Issue #	Issue/Question Description	Raised by	Date Raised	Status
3	Quantify the benefits for "preamble re-trigger" and specify if necessary • How many parallel decode paths are needed? • How to deal with sync pattern in the data?	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-5-11A CLOSED**
4	What is the optimum sync threshold "score" that is best matched to the overall message decoding success while minimizing false alarm for re-trigger? Should the threshold be specified? If so, how is it tested? **Being addressed in new Appendix H.**	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-4-12 WP-4-18 WP-5-11A CLOSED**
5	Can a minimal installation without an "On Ground" indication continue alternating top and bottom antennas for transmit without significantly sacrificing performance?	Chris Moody UAT-WP-2-06	20 Feb 01	
6	What is the minimum isolation required for antenna switching (20 dB in 1090 MOPS)?	Chris Moody UAT-WP-2-06	20 Feb 01	
7	Is an explicit specification needed to describe the filtration on the transmitted signal? If so, how to specify? If not, what implementation loss are we allowing?	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by several Action Items ???
8	What kind of receive filtration specification is required?	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by several Action Items ???
9	What minimum specification is required on baud rate timing to allow reception of the entire uplink using a single sync sequence? Is it practical to require this minimum? **Answer is 20 PPM.**	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-4-11**
10	Whether or not to require an algorithm to determine On-the-Ground status	Section 2.2 discussion	2 May 01	
11	Given that the agreed-upon solution to Coding Selected Altitude appears to add 2 bits, we will remember that we can revisit this issue later if we need to recover those bits.	Discussion on Coding Selected Altitude in WP-4-03	3 May 01	